# The Process of Developing Animated Cases as Pedagogy supporting Classroom Management Instruction

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**Abstract**

*Classroom Teaching is a very challenging process. Teachers go through a rigorous training process to ensure their mastery of the content material and as a part of teacher training preparation they are given instruction and strategies to properly deliver this information to students. New teachers have an extensive teacher training process to learn more about their subject matter and to learn instructional strategies. There are many different methods of attempting to engage teachers to understand classroom environments and improve teaching capabilities. Technology holds a great potential for improving the quality of education for learners. Information technology can be utilized to aid educators if the tools are user friendly and have a great ease of use. With well-designed and usable tools, instructors will be able to use them to better engage and captivate students. Spectrum Educational Consulting mainly focuses on the problems teachers face with respect to classroom management, introduces them to difficult scenarios and illustrates effective methods of classroom management. Spectrum Education Consulting incorporates multimedia animations as an extension to textual case studies.*

**Keywords.** Classroom Management, Pre-service teacher training, Online Educational Environments, Animated Simulations, Prototype, Usability, User Study, Novice Teacher

## 1. Introduction

Teachers go through a rigorous training process to ensure their mastery of the content material and as a part of teacher training preparation they are given instruction and strategies to properly deliver this information to students.

Each teacher will have a firm foundation with a degree in that subject matter and a certificate from their state that attest that they have been approved to teach this subject matter. New teachers have the credential, but will need practice to groom their instructional skills. Good instructional skills are the keys and to ensuring that students understand the content materials. The classroom environment can also aid in the teaching process. Teachers have been instructed to face challenges in the classroom and use their knowledge and to overcome these difficulties. Teachers are prepared to enter the classroom, but are not prepared for all the challenging circumstances that may arise during a day in the field in their own classrooms.

Teachers are trained in various classroom management techniques and adopt various practices in order to make their classroom experience more fruitful and supportive of a learning environment for their students. During the preparation of their lesson plans, the teacher needs to plan episodes for lecturing, student involvement by engaging them to participate in discussions and role-plays, presenting appropriate examples or illustrations, etc. All of this preparation will provide support for teachers to be more successful in classroom teaching. Pre-service teachers have an extensive teacher training process to learn more about their subject matter and to learn instructional strategies. Yet there has been tremendous growth in the availability of technology and mobile and wireless devices. This presents a great opportunity to support learners in different ways of learning and interacting with content matter. One recent significant change in the learning environment is the demand to provide more accessibility to applications. What if teacher training can be implemented online and can be accessed at any time? This research aims towards implementing pre-service teacher training through animated case studies. Delivering materials online gives an advantage of accessing the application any time and by any type of smart device. This practice will certainly help in reducing equipment cost in delivering education. It will be more effective and entertaining to use interactive online applications as learning media. E-Learning consists of all forms of electronically supported learning and teaching. E-Learning is also defined as computer enabled transfer of knowledge. Educational and other forms of content are delivered via Internet, audio, video and animations. This kind of learning gives the users a chance to find and learn what they really wanted to and at a convenient time and place.

### 1.1 Problem Statement

There are many different methods of attempting to engage teachers to understand classroom environments and improve teaching capabilities. Technology holds a great potential for improving the quality of education for learners; however, if the created technology is not designed with a user-centric approach, it will inevitably fail to achieve the desired effect. It is hard to gauge a learner's comfort level and ability to navigate and comprehend technology, which is generally directly correlated to the environment in which they grew up and what they are comfortable with. Information technology can be utilized to aid educators if the tools are user-friendly and have a great ease of use. If tools are well designed and usable, instructors will be able to use them to engage and captivate students.

Many of the present methods available for instructing pre-service teachers are not as effective as they should be. Various data has shown that visual case studies are an important measure in improving the effectiveness of training (Boling, 2007). Animated Web tutorials are a form of visual education tools. Animation can showcase one's creativity and makes even the toughest concepts easier to comprehend. Our aim is that by incorporating animation into the existing textual case studies, teachers would be able to grasp concepts much more effectively. It will allow them to practically visualize the classroom environment and get a feel of the situation. The major advantage of developing online educational simulations is that they can be accessed anytime and anyplace where Internet access is supported. Many of the currently available tools are created in flash, which in many cases is outdated technology as it is not supported by many handheld devices. Interactive case studies also provide support for critical thinking and reflection skills, then a static video of an example case. The purpose of this study was to develop a low-cost educator friendly, web and mobile-oriented learning environment centered on ease of use and interactive technology for the educator so that the users can gain access to the educational content anytime and-anyplace.

With the aforementioned problems in existing tools and the advantages involved in creating animated simulations for case studies for teacher training, we have come up with a new tool called the 'SPECTRUM EDUCATION CONSULTING', which is created to support teachers in practicing their classroom management techniques. The currently existing case studies are presented in a text-based format and for most of the teachers, this static representation is what they are usually provided for content reinforcement.

This project plans to utilize existing scenarios as requirements and to develop an intriguing interactive case studies application that is appealing, colorful and interactive animated case studies.

Spectrum Education Consulting incorporates multimedia animations into textual case studies. Spectrum Education Consulting mainly focuses on the problems teachers face in the classroom and helps them overcome those difficult situations and show them effective ways of teaching. Spectrum Education Consulting uses the next generation solution for web-based animation (HTML5/JavaScript), which is supported on almost all the devices than the previous generation of flash. The style of interaction utilized by these case studies will support novice teachers in classroom management and decision-making. These case studies also allow teachers to teach classes in productive ways and also help them to address various classroom challenges. Our design was a low cost, graphical, web-based, mobile supportive interface that targets a wide range of platforms. Pre-service teachers can gain access to the animated case studies, and our hope is that teachers find it interesting and instructive to access the content online through their mobile devices.

### 1.2 Research Purpose

The primary objectives of this research are to:

- Investigate pre-service teacher training methods that are currently available that facilitate teachers to understand traditional classroom experiences.
- Investigate the affordances and constraints involved in developing an online educational application that can support pre-service teachers in a capacity that is easy to use, meets all the requirements and is engaging for the learners.
- Design and develop an online educational application that can be accessed across all different mobile platforms and browsers. The application should allow teachers to interact with the system. Teachers should feel comfortable using the system and learning the workflow.
- Determine if the developed prototype is acceptable from the user interface standpoint.
- Determine if the developed prototype is acceptable for pre-service teacher training.

### 1.3 Hypothesis

The main hypothesis of this study is that animated case studies of classroom scenarios and environments would be more helpful for pre-service teachers to deliver educational content. Teachers will have the ability to access the information anywhere and at any time and will be more engaging if the content is delivered through easy and interactive mobile environments. Unlike traditional textual case studies, this form of content also helps pre-service teachers in understanding the problematic situations that would arise in classrooms effectively and an interactive way. This study also concentrates on involving users in the learning process by providing them control over the flow. User interactivity plays a major role in online learning environments, and this research implements this principle.

Online learning environment better supports learners as opposed to structural educational environments. Mobile devices have become a basic essential element in human lives and this research will be usable on mobile platforms. In our evaluation, we will assess the information quality and interaction quality. We have two populations planned to assess the system (i.e. participants that have completed COMP 7620 or COMP 6620 courses so that they have usability training knowledge and teacher education specialists to help in determining the effectiveness of the interactive case study and simulations.

## 2. Background

### 2.1 Multimedia Systems in Education: Effects of Usability on Learning

Multimedia systems are used more and more in distance learning. In this kind of training, face to face interaction does not occur between the teacher and the learner. The main idea behind the implementation of multimedia systems into education is the belief that multimedia products help people to improve their learning process. Some meta-analyses have been conducted to compare learning in a traditional classroom situation to learning using multimedia systems (Parlangeli et al., 1999). Two variables – effectiveness and time are being considered important in testing the usability of multimedia systems on learning. Various studies have confirmed that learning is more effective when the information is presented utilizing a multimedia application. Training involving computer-based instruction has the advantage of saving time. Learners save 70% of their time using multimedia learning than learning in traditional classrooms (Bosco, 1989).

In spite of various studies supporting that multimedia products are effective tools to improve learning, some studies also reveal that the effectiveness of multimedia systems on the learning processes decreases over time (Clark & Craig, 1992). However, these findings do not deny the effectiveness multimedia systems have in other learning environments. There is thus the strong support to maintain that multimedia systems are effective for supporting the learning process.

Various studies have discussed the way in which the level of usability of the system can affect the effectiveness of a multimedia training course. Three studies have been performed on a multimedia training course. In the first study, the usability of the system has been evaluated by performing a heuristic evaluation. In the second study, the usability of the system was tested by involving end users (Parlangeli et al., 99). Results from these studies were used to determine the level of usability of the system. These results also gave some indication of its effectiveness as a training tool. An experiment was carried out to evaluate the students' learning performance. The system being tested is an educational tool developed to support learning about the limits of functions.

*First study: heuristic evaluation* – Usability is a key issue in human–computer interaction. Spectrum Education involves the interaction of the learners with the system. Usability is widely accepted as a general indication of the quality of the user interface. Usability is referred to as a multi-factorial concept which relates to the ease of use, effectiveness, and user satisfaction of a system (Redmond-Pyle & Moore, 2005). The choice of method used for usability evaluation is affected by factors such as time, money, and other theoretical considerations. Heuristic evaluation is an expert-based approach involving some reviewers, who are experts in the field of human-computer interaction, to test the system in order to detect potential pitfalls in the user interface (Redmond-Pyle & Moore, 2005). Reviewers apply their expertise and the use of general human factors principles in actively identifying violations in the multimedia user interface. This method has various advantages, such as cost-effectiveness, and most importantly, it is quick and easy. The experts used the following guidelines: (a) use simple and natural dialogue; (b) use the user's language; (c) minimize user memory load; (d) be consistent; (e) provide feedback wherever necessary; (f) providing clearly marked exits; (g) provide good error messages; (h) prevent errors (i) allow the user to feel in control of the system. Spectrum Education follows these guidelines in the development of animated simulations for elementary teachers in order to improve the learning process of the teachers. Both the reviewers examined the system with these guidelines and took notice of the violations from the given guidelines.

*Second Study – user-based evaluation* - The user-based approaches involved real-end users interacting with the system. Many techniques, including a video recording of the interactions, are utilized to obtain measurements of relevant variables. Although this method is time-consuming and relatively expensive, the results coming out from this evaluation are effective since the end users are directly tested during their interaction with the system. The test was done in three phases. In the first phase, the users were given a questionnaire which was aimed at obtaining information about their computer experience. The questions given were related to the amount of experience users had with using the computers. In the second phase, users interacted with the application. The user experience while they are interacting with the system is observed using video recording. In the third phase, users are given a post questionnaire to evaluate the effectiveness of the system. Overall subjective evaluation, ease of learning and how to use the system, evaluation of the graphical aspect of the user interface are all tested in this phase. The analysis of the interaction test was conducted by referring usability problems to the same principles adopted in the heuristic evaluation. The user's mistakes along with the reasons were identified.

The results obtained from these two phases have been collected and studies were completed. The first phase results help to improve the user interface, while the second phase results help in improving the effectiveness of the multimedia system. Spectrum Education also uses a questionnaire that analyzes the targeted audience interaction with the developed system and their behavior while interacting with the system.

Computer Supported Collaborative Learning is a great innovation in the field of E-Learning, which is used mainly to improve teaching and learning. Computer Supported Collaborative Learning takes help from the latest information and communication technology (Stahl et al, 2006).

*Communication* technologies are generally categorized as asynchronous and synchronous. Asynchronous activities use technologies such as blogs, discussion boards, etc. The main concept behind this kind of communication is that participants may engage in the exchange of information without the presence of other participants (e.g. email). Asynchronous learning also gives learners the ability to work at their own pace.

*Synchronous* activities involve the exchange of ideas and information with one or more participants during the same period of time. A face to face discussion is an example of a synchronous communication. *Synchronous* activities occur with all participants joining in at once, as with an online chat session or a virtual classroom or meeting.

Virtual classrooms and meetings can often use a mix of communication technologies. Participants in a virtual classroom use icons referred to as emoticons to communicate feelings and responses to questions or statements. Other communication technologies that are available in a virtual classroom include text notes, microphone rights, and breakout sessions. Breakout sessions allow the participants to work collaboratively in a small group setting to accomplish a task.

Learners get control over the content, the learning sequence, and the pace of learning through the use of E-Learning. Even multimedia content allows them to tailor their experiences to meet their personal learning objectives. This way of learning has advantages such as providing learners with high levels of learning effectiveness. Learners are more satisfied with learning materials and learning environments. Growth in technology, digitization, and development of the Internet has influenced our society in many aspects. E-Learning helps to integrate these technologies and knowledge and consent learners to learn new knowledge at anytime and anywhere with no time and space constraints (Won, 2008).

In *asynchronous* online courses that are a form of E-Learning, students proceed at his or her own pace. If they need to listen to a lecture a second time, or think about a question for a while, they may do so without having the fear that they will need to hold back the rest of the class. Through online courses, students may earn their diplomas more quickly, or repeat failed courses without the embarrassment of being in a class with younger students. Students also have access to an incredible variety of enrichment courses in online learning, and can participate in internships, sports, or work. Spectrum Education is a form of asynchronous online teaching material developed for elementary teachers that give the teacher's time to prepare and get an understanding of the real time classroom difficulties. It is also asynchronous in the way that the teachers can prepare and understand the content at their individual pace.

All these factors tell us the importance of E-Learning and its benefits as well as its drawbacks. However, E-Learning can be more beneficial when taken to the next level (Bondelli, 2006). Spectrum Education involves using E-Learning in educating pre-service teachers by helping to prepare them for the classroom environment with exercises in classroom management. Also, utilization of multimedia and interactivity in the case studies helps them to get a feeling of how the real classroom environment may be. These case studies also help new teachers by providing examples of effective teaching to students. This research is also developed with an aim to provide learner access to the system across various browsers and mobile phones, etc.

### 2.2 Multimedia Cases in Elementary Teacher Training

Caroline and Gary investigated the teacher's ability to learn, apply their learning in lesson plans, and retain knowledge of classroom disclosure from a single module of a multimedia case study with K-12 teachers (Pryor & Bitter, 2008). Data collection and analysis included teacher development of lesson plans and learning and application of various discourse strategies.

Technology-based programs serve as a strategy for increasing a teacher's experience with technology and also to improve their knowledge of learning standards. Some of the beneficial attributes of multimedia programs for elementary teacher learning are learner control and multiple modalities accommodating learning styles. The need for teachers to learn strategies for implementing classroom disclosure is supported by a growing body of literature (Pryor & Bitter, 2008). Disclosure can be defined as the way in which ideas are exchanged. Disclosure can be the teacher to class, teacher to student or student to student. Teachers promoting the classroom have various advantages for students, including a classroom environment of reasoned enquiry, increased conceptual development, increased knowledge of a domain area, and improvement of skills related to knowledge (Al-Mekhlafi, 2000). Reports explain the teacher's role in encouraging classroom disclosure. This helps for a democratic classroom environment in which students feel free to share beliefs and opinions. Teachers often struggle with learning how to acquire disclosure skills.

Reflection often functions as an advanced organizer that prompts ideas and strategies that teachers pay attention to while learning from multimedia systems.

Spectrum Education achieves this strategy by allowing teachers to consider reflection questions after the case study. Providing opportunities for reflection in teacher professional development programs suggested an increase in teacher's ability in various areas, including developing skills in analyzing their own teaching. Also, reflection mechanisms help teachers develop structures of personal pedagogy, and align an approach to teaching with selected teaching strategies. Professional teacher development programs involving multimedia should involve reflection techniques.

Multimedia cases aim for the professional development of prospective teachers in elementary education. These cases simulate and facilitate the prospective teacher's reflection on learning and teaching. They consist of animations of classroom events as well as audiotape information and text. Bitter and Pryor (2006) investigated whether teachers can improve their ability to implement classroom discourse after their interaction with multimedia professional development programs. Gains in the knowledge of discourse, ability to reflect on practice, and ability to promote classroom discourse have been observed among teachers involved in the program. Teacher's perceptions of the effects of what they had learned and their reflection in the real class have been studied. Analysis of the teacher included in the development program was tested in accordance with the National Council of Teachers Professional standards for teaching.

- *Posing questions and tasks that elicit, engage, and challenge each student's thinking.*
- *Listening carefully to students' ideas.*
- *Asking students to clarify and justify their ideas.*
- *Deciding what to pursue in depth from among the ideas that students bring up during a discussion.*
- *Deciding when to provide information, when to clarify an issue, when to model, when to lead, and when to let a student struggle with a difficulty.*
- *Monitoring students' participation in discussions and deciding when and how to encourage each student to participate.*

*The main questions that were asked of the teachers after the program are:*

- *What do you remember about using the module?*
- *What do you remember learning from the module?*
- *Have you used what you learned in your teaching?*
- *What is the effect of using discourse standards on your student's achievement? (*Bitter & Hatfielf, 1997*)*

This analysis provides a view of how the multimedia development program improves the teacher's ability in various aspects of the classroom environment and also allows improving the program (Bitter & Hatfielf, 1997).

Spectrum Education also involves reflection. It allows teachers to view a real time class situation. This enables teachers to retain the knowledge they achieve from these case studies for a long time (i.e. through visual reinforcement) and use them in their classroom environment. Spectrum also provides opportunities to reflect recursively on strategies useful in classroom discourse. Studies also found that with much more integration of multimedia into development programs and the addition of various text and video vignettes, providing analytic prompts could be helpful in improving teacher's knowledge.

Multimedia cases bring various changes in teacher education by shortening the gap between theory and practice. By utilizing Information and Communication Technology in multimedia cases, a powerful and flexible learning environment can be created (Berg van den; Visscher-Voerman, 2000). Koc. Perker & Osmanoglu examined the importance of using video case studies with in-service and pre-service teachers. They found that the case studies were very helpful for the professional development of the teachers (Koc et al. 2009). Results also proved that as a result of watching video cases, both pre-service and in-service teachers showed gains in their ability to discern and interpret the features of classroom teaching. The video case studies also improved the quality of teacher discourse and reflection. Spectrum Educational Consulting follows these examples of multimedia and online learning in the development of online educational content. Spectrum Education Consulting also adds reflection questions that are used to improve a user's interactivity with the system. It also depicts real world contexts.

## 3. Method & Motivation

Computing technologies have been applied to education for decades. Access to information has become an easy and an interactive process helping the learner to have access to the content of his choice. The ready availability and easy access to applications have been flourishing with the advent of the web.

Easy access to content has supported the concept of E-Learning and learning through the Internet offers many advantages. Learners have control over the content, the learning sequence, and the pace of instruction through the use of E-Learning. Also interactive multimedia content allows them to tailor their experiences to support their personal learning objectives. E-Learning offers a higher level of learning effectiveness. Learners are more satisfied with learning materials and learning environments.

Initially, case studies for pre-service teacher training were in the form of textual case studies. These case studies are textual descriptions of an author who narrates the case study. At the end of the case study, reflection questions based on the situation allow teachers to think and analyze the situation in the case study. After the case study, the narrator explains his analysis of the reflection questions and shares his thoughts. The prototype Version 1 of pre-service teacher training was based on textual case studies and explored presenting this material as animated simulations; however, there were various drawbacks. One of the major drawbacks of this version was little user interactivity. Learners did not have the ability to interact with the application and the aesthetic quality of the simulation needed improvement. The simulation did not appear realistic because the character animations were not smooth or continuous resembling a cartoon flip book and not supported on all browsers. Version2 of the spectrum application uses the next generation solution for web based animation (i.e. HTML5/Javascript), which is supported on more devices (e.g. web and any mobile device).

## 4. Proposed Educational Environment

The planned educational environment (Spectrum Educational prototype two) consists of a learning environment for teachers. It is poised to replace the current environments which are not portable to multiple browsers and platforms. The proposed educational environment also supports user interactivity. It was developed to overcome usability issues and to convert text-based scenarios to animated scenarios.

We utilize a tradition software lifecycle that begins with *Requirements Analysis:* This is the phase where the requirements are defined and the design team gathers information to support detailed system development. The team works with the client to refine the problem statement and propose solutions through software to support this problem. In the Spectrum Education scenario is to support new teachers in classroom management strategies. There are many ways in which pre-service teacher training can be fruitful and we want to utilize online learning to support content reinforcement, critical thinking and evaluation of scenarios through reflection questions. When creating this system we want to support ease of access and repeatable reinforcement and potential support for a large number of teachers and students remotely.

Our next step is System *Design* to develop a solution to the problem that we will mitigate through a software solution. The solution developed describes a possible way to attend the requirements identified in previous teacher training applications. Based on feedback from Spectrum Education Version1, Version2 will be much more interactive and instructive to teachers. To support visual learner we have converted, long text based scenarios into animated scenarios. Our next step is *Implementation where we focus developing the solution*. The code was developed in HTML5 and JavaScript which improve the accessibility of the application (i.e. access through mobile and web). The next stage *is Testing to investigate* whether the code works as expected and meets the systems requirements. We will plan on incremental testing of the software system and usability testing of the system's usability with planned users of the system through the questionnaire.

### 4.1 Spectrum Prototype Use Case Scenarios

The following is an example of a Use Case Scenario for a user interaction with the system.

User (*Primary Actor:* User; *Secondary Actor*: None)

*Description:* This use case scenario is for users who need to register for the first time to log into the system where all the files related to Spectrum Education are kept. The user can view the animated simulations related to Spectrum Education Consulting. The request sent by the user goes to Database (DB) Admin; the DB Admin accepts the request and approves the login credentials.

*Pre Conditions:* The user should have a desktop/laptop/mobile phone in working condition with internet connectivity on any of the mentioned devices.

*Post Conditions:* The DB Admin must have knowledge on approving log in credentials for the requested users.
*Basic Flow:*

- The user sends a registration request to DB Admin with his email, username and password.
- The DB Admin can accept/reject the request based on the availability of username.
- If the DB Admin rejects the request then the user has to select a new username.
- If the DB Admin accepts the request, the user will have the login credentials.
- Once the user has the log in details received from the DB Admin, he can access files related to Spectrum application.
- The user can view the simulations which are provided on the Spectrum webpage.

**4.2 Description of Intial Study**

The goals of the study were to (a) familiarize pre-service teachers with the new Spectrum Education Consulting prototype, (b) to improve usability features of Spectrum compared to other teacher training methods, (c) to visualize classroom environment to teachers using animated simulations, (d) to allow teachers to interact with the system, (e) to allow teachers to improve their reflection skills by allowing them to answer the reflection questions on the scenarios Once the planned environment is developed, a survey was designed to evaluate the application. A series of tasks were given to the testing participants which can be done in their leisure time, and once the task was completed, they were asked to do the questionnaire which asks for their experiences while using the system.

**4.3 Experimental Procedure**

Since the experiment surveys are to be entered online, the participant can take the surveys in their leisure time.

- An email is sent to the participants describing the study and why they are chosen.
- The email consists of a link to the information letter that describes in detail about the research and gives the option for the user to continue to the animated simulations
- The participants will take their own time in understanding the prototype
- Then the participants will answer a questionnaire to provide feedback in the areas of usability, information quality, and interaction quality.

All the links will be through online survey. The questionnaire will take not more than 10 minutes.

**4.4 Implementation**

Based on the design requirements, the system was developed using HTML5, PHP (Hyper Text preprocessor), JavaScript, and MySQL. We also used Adobe Dreamweaver, which is a web development application tool. This chapter discusses the details behind successfully configuring and developing the proposed model for pre-service teacher training. Figure 1 illustrates the homepage of spectrum prototype. HTML5 provides mobile device users with rich web applications and improved usability than the previous version. JavaScript provides enhanced user interfaces and dynamic websites. MySQL is a relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases and is the world's most popular databased used to provide storage and retrieval of application materials.

Once the registration is complete, the teachers will login with the username and password created. Once he logs in, he will be directed to the home page that includes links to all the scenarios and also the information regarding Spectrum Educational Consulting. The animated simulations were developed using JavaScript and HTML5 features. A screenshot of the animated simulation is shown in Figure 2.

For the development of animated simulations, all the images required to develop the scenario are collected and are edited using Paint, Photoshop, and Gimp. Gimp is an image manipulation tool. Using Gimp, various images are converted into different forms so that we can represent characters in the case study in different forms. These images are called sprites which are used as characters in the development of animated simulations. Some of the screenshots of sprites are shown in Figure 3 & 4, which shows the characters in different forms. Once the sprites were developed, we needed to construct the scenario by loading the sprites. Then, we needed to write the code to animate the sprites and illustrate the different scenes.

Each case study consists of an animated simulation. The animated simulation is navigated by the user with the aid of user interacting specifically through a click of the mouse. The animated simulation involves various sequences of steps. In each sequence, a scene is developed using the images and characters required in the scene. At the end of the case study, reflection questions are given to the teachers which enable them to think and understand different challenges that may be faced with in their own classroom. Also, to further involve teachers in this learning process, they are given options for reflection questions to have them to consider scenario options.

Once teachers select an option, they are notified of the correct answer through animated simulations and also given justifications. Depending on the answer they select, they are navigated to the appropriate ending of the scenario. The animated simulations developed are more useful and provide a much deeper impact on teachers than the other textual case studies alone. Also, the animated simulations allow teachers to view the classroom environment and also allows them to get prepared for different types of problematic environments that they could face.

## 5. Results and Analysis

As stated in chapter 1, the primary objectives of this study are to address the following research questions:

- Investigate pre-service teacher training methods that are currently available that facilitate teachers to understand traditional classroom experiences.
- Investigate the affordances and constraints involved in developing an online educational application that can support pre-service teachers in a capacity that is easy to use, meets all the requirements and is engaging for the learners.
- Design and develop an online educational application that can be accessed across all different mobile platforms and browsers. The application should allow teachers to interact with the system. Teachers should feel comfortable using the system and learning the workflow.
- Determine if the developed prototype is acceptable from the user interface standpoint.
- Determine if the developed prototype is acceptable for pre-service teacher training.

To address these research questions, a series of studies were conducted in spring 2011 and summer 2011. The existing pre-service teacher training tools were studied and discussed in earlier chapters. Spectrum Educational Consulting, an online educational tool is designed to address all these research questions. The developed tool is tested with three groups (students, teacher education specialists, and human computer interaction specialists) of users using a questionnaire survey. The results from these surveys provided information about users perceive the developed application and if the proposed application is acceptable for pre-service teacher training. There were 32 users who have tested the application and gave their opinions through online survey. The user survey consisted of three sections. The first section had questions regarding the system usability. The second section had questions regarding information quality and the third section had questions regarding interaction quality. Likert-type scale was used for the questionnaire.

### 5.1 Results of Usability for Spectrum

The results from this section of the survey gave the user's perception of the system from the usability point of view. Data was collected on a seven point scale, 'strongly disagree' being the lowest and 'strongly agree' being the highest. On a scale of 1-7, the average rating in each of the satisfaction categories was nearly 5. Their response to the system was better than expected by the researchers. We anticipated that the response would rate about 4 out of 7. Eighty-five percent (85%) of the participants indicated they were satisfied about the ease of the use of the system. Figure 19 shows the participants' responses to the usability question 'Overall, I am satisfied with how easy it is to use this system?' regarding the Spectrum Education application. However, a small amount of the participant population indicated that they did not find it easy using the system. This indicates that we need to provide greater support and improved usability for novice with less computing efficacy. Average response to all the usability questions in the survey indicated a positive response to the application from the usability viewpoint. Figure 20 shows the response to the participants view on how comfortable they were when using the system. The average response was a positive indication with respect to comfort with using the system with 97% of users finding the system comfortable to use with only one user (i.e. less than 3%) that did not find the system comfortable to use. The system was tested against the following range of usability factors – (dull – stimulating, rigid – flexible, terrible – wonderful, frustrating – satisfying). The results indicated that the majority of users found the system Flexible, Wonderful, and Satisfying. Table 1 represents the summary of data reported by the three sets of participants regarding system's usability. Judging by how users rated the system, we can see that most of them responded that the developed system had great usability features. This supports one of the goals of the research, which was to build a learning environment that was intuitive, user friendly and easy to use and learn.

More than 90% of the participants indicated that the developed system provides them broader access than currently available pre-service teacher training methods. These results indicate that animated simulations of the case studies are helpful for the teachers in preparing for the classroom environments than the previous forms. Table 2 represents the summary of data reported by participants regarding system's information quality.

The results in the table indicate an average rating of more than 6 on a 7 point scale for all the questions regarding the information quality of the system. The average rating for the responses to the questions regarding whether the reflection questions were helpful for the users was almost 7 the maximum rating. This indicates that the developed system was useful for the teachers to think about different problems that they could face in classroom. The responses also indicated that participants indicated the feedback to the reflection questions given through animation was more helpful than provided through textual forms.

## 6. Conclusion

Spectrum Educational Consulting V2.0 is a great tool for aiding pre-service teachers in learning about classroom management scenarios in a way that is interactive and engaging. Using Spectrum to will be a wonderful aid for teachers and allows teachers to practically visualize classroom environments through animated simulations. We have provided access to this tool as an online learning environment and also is supported on mobile phones. The interactive content was the key to improve the system over the previous version and providing content in a user friendly format to support pre-service teachers in their teacher training process. The animated simulations will support novice teachers in classroom management and decision-making through practical reinforcement of pedagogy. These simulations also provide reinforcement anywhere anytime and give scenarios and suggestions to address various classroom challenges.

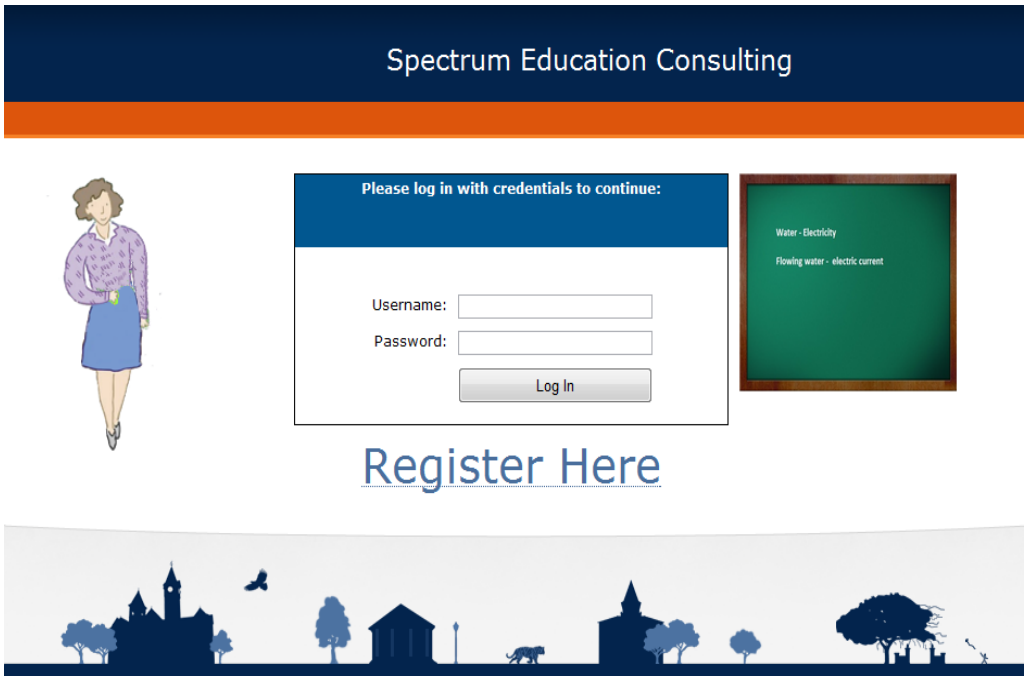


**Figure 1: Spectrum V2.0 Educational Consulting Home Page**

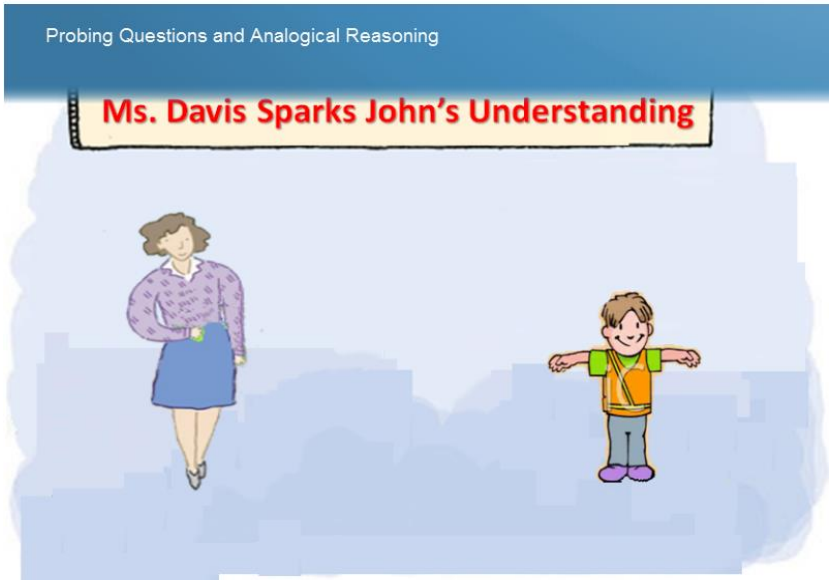


**Figure 2: Animated case study**

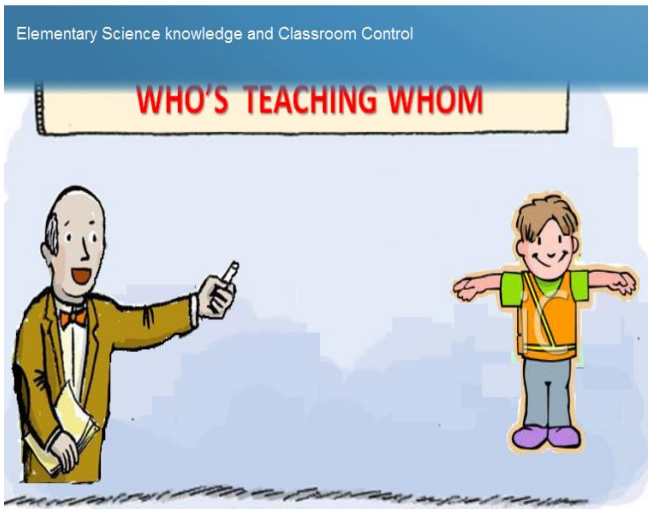


**Figure 4: Classroom sequence**

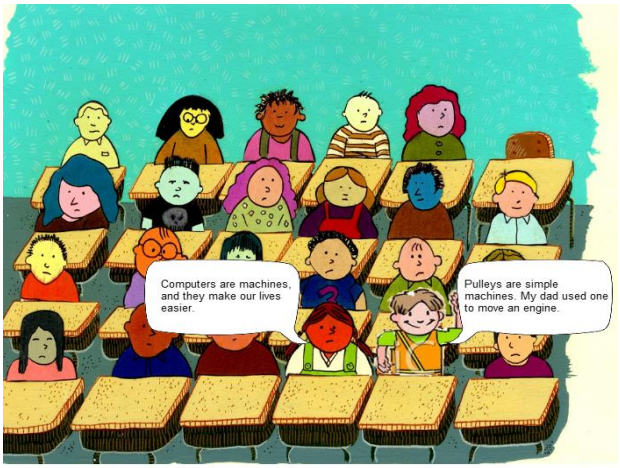


**Figure 3: Animated case study**

| Rating Weight | Strongly disagree | 2 | 3 | 4 | 5 | 6 | Strongly agree | N/A | Rating Average |
|---|---|---|---|---|---|---|---|---|---|
| It was simple to use this system. | 0 | 1 | 0 | 0 | 8 | 12 | 11 | 0 | 5.97 |
| It was easy to learn to use this system. | 0 | 0 | 1 | 0 | 14 | 6 | 10 | 0 | 5.77 |
| I can effectively complete my work using this system. | 0 | 0 | 0 | 2 | 11 | 10 | 9 | 0 | 5.81 |
| I am able to complete my work quickly using this system. | 0 | 0 | 0 | 1 | 8 | 15 | 7 | 0 | 5.90 |
| I am able to efficiently complete my work using this system. | 0 | 0 | 0 | 2 | 10 | 10 | 9 | 0 | 5.84 |
| Layout /Colors of the interface is visually appealing | 0 | 0 | 0 | 2 | 4 | 12 | 13 | 0 | 6.16 |
| Understanding the content (Difficult - Easy) | 0 | 0 | 0 | 3 | 13 | 9 | 7 | 0 | 5.63 |

**Table 1: Questionnaire results for System Usability**

| Rating Weight | Strongly disagree | 2 | 3 | 4 | 5 | 6 | Strongly agree | N/A | Rating Average |
|---|---|---|---|---|---|---|---|---|---|
| It is easy to navigate through the scenarios. | 0 | 1 | 0 | 0 | 7 | 11 | 14 | 0 | 6.22 |
| The information provided with the system is easy to understand. | 0 | 0 | 1 | 1 | 3 | 13 | 15 | 0 | 6.31 |
| The information is very much helpful for me to prepare for classes. | 0 | 0 | 0 | 1 | 2 | 18 | 11 | 0 | 6.22 |
| Interaction between scenarios improved my reflection skills. | 0 | 0 | 0 | 0 | 5 | 11 | 16 | 0 | 6.34 |
| Based on this experience, I will use Spectrum to access the course materials in the future. | 0 | 0 | 0 | 1 | 3 | 17 | 11 | 0 | 6.19 |
| The organization of information in the scenarios is clear. | 0 | 0 | 0 | 0 | 5 | 8 | 19 | 0 | 6.44 |
| Reflection Questions allowed me to think about different problems that I could face while teaching classes. | 0 | 0 | 0 | 1 | 2 | 14 | 15 | 0 | 6.34 |
| Feedback to the reflection questions through animation was more helpful than the textual form. | 0 | 0 | 0 | 1 | 4 | 11 | 16 | 0 | 6.31 |

**Table 2: Questionnaire results for Information Quality**

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